PATENT
Attorney Docket No. 401164

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

PARK et al.

Art Unit: Unassigned

Application No.: Unassigned

Examiner: Unassigned

Filed: April 12, 2001

For: APPARATUS AND METHOD FOR DIGITAL MULTIPLICATION USING REDUNDANT BINARY ARITHMETIC

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Prior to the examination of the above-identified patent application, please enter the following amendments and consider the following remarks.

IN THE SPECIFICATION:

Replace the paragraph beginning at page 1, line 16 with:

In a multiplication arithmetic algorithm used in conventional multipliers, partial products are obtained using a modified booth's algorithm (MBA) and are added by a carry-save adder having a structure such as a Wallace-tree, to thereby obtain a final multiplication result. This multiplication is usually achieved using normal binary arithmetic. Here, the partial products can be summed using a redundant binary arithmetic technique instead of normal binary arithmetic technique. The characteristic of redundant binary arithmetic is that there is no continuous propagation of carry as required by general arithmetic for summing partial products.

IN THE CLAIMS:

Replace the indicated claims with:

1. (Amended) A digital multiplication apparatus adopting redundant binary arithmetic for multiplying a number X by an m-bit number Y to produce a product, using a radix-2k number system, the apparatus comprising:

a data converter for data-converting the m-bit number Y into m/k-digit data D ($= D_{m/k-1}D_{m/k-2} \ldots D_i \ldots D_1D_0$);

a partial product calculator for converting each of the digits Di of the m/k-digit data D converted by the data converter into a combination of coefficients of a fundamental multiple, multiplying the combination by the number X, to produce redundant binary partial products;

a redundant binary adder for summing the redundant binary partial products for each of the m/k-digit data D to produce a redundant binary sum; and

a redundant binary (RB)-normal binary (NB) converter for converting the redundant binary sum into a normal binary number and outputting the normal binary sum as the product of the two numbers X and Y.

8. (Amended) A digital multiplication method adopting redundant binary arithmetic for multiplying a number X by an m-bit number Y to produce a product, using a radix-2k number system, the method comprising:

(a) data-converting the m-bit number Y into m/k-digit data D ($= D_{m/k-1}D_{m/k-2} \ldots D_i \ldots D_1D_0$);

(b) converting each of the digits Di of the m/k-digit data D into a combination of coefficients of a fundamental multiple, and multiplying the combination by the number X to obtain redundant binary partial products;

(c) summing the redundant binary partial products for each of the m/k-digit data D to produce a redundant binary sum; and

(d) converting the redundant binary sum into a binary number to obtain the product of the two numbers X and Y.

IN THE ABSTRACT:

Replace the Abstract with:

Abstract of the Disclosure

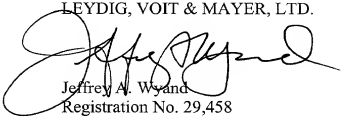
A digital multiplication apparatus and method adopting redundant binary arithmetic is provided. In this digital multiplication apparatus, when two numbers X and Y are multiplied using a radix-2k number system, a data converter data-converts the m-bit number Y into m/k-digit data D (= $D_{m/k-1}D_{m/k-2}$ .... D_i ... D_iD_o). A partial product calculator converts each of the digits Di of the number Y converted by the data converter into a combination of the coefficients of a fundamental multiple, multiplies the combination by the number X, and outputs the product as a redundant binary partial product. A redundant binary adder sums the partial products for all of the digits of the converted number Y. A redundant binary (RB)-normal binary (NB) converter converts the redundant binary sum into a normal binary number and outputs the converted normal binary sum as the product of the two numbers. Therefore, even when the radix extends, the burden upon hardware can be minimized. Also, many systems having multipliers serving as important components can be more simply constructed.

REMARKS

The foregoing Amendment correct translation errors and conform the application to U.S. requirements.

Respectfully submitted,

LEYDIG, VOIT & MAYER, LTD.



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SPECIFICATION, CLAIMS AND ABSTRACT AS PRELIMINARILY AMENDED

Amendments to the paragraph beginning at page 1, line 16:

In a multiplication arithmetic algorithm used in conventional multipliers, partial products are obtained using a modified booth's algorithm (MBA) and are added ~~up~~ by a carry-save adder having a structure such as a Wallace-tree, to thereby obtain a final multiplication result. This multiplication is usually achieved using ~~a~~ normal binary arithmetic. Here, the partial products can be summed ~~up~~ using a redundant binary arithmetic technique instead of ~~a~~ normal binary arithmetic technique. The characteristic of ~~a~~ redundant binary arithmetic is that there is no continuous propagation of carry ~~is the property of an adder~~ as required by ~~a~~ general arithmetic for summing ~~up~~ partial products.

Amendments to existing claims:

1. A digital multiplication apparatus adopting ~~a~~ redundant binary arithmetic for multiplying ~~two numbers~~ a number X ~~and~~ by an m-bit number Y to produce a product, using a radix-2k number system, the apparatus comprising:

a data converter for data-converting the m-bit number Y into m/k-digit data D ($= D_{m/k-1}D_{m/k-2} .... D_i ... D_1D_0$);

a partial product calculator for converting each of the digits Di of the ~~number Y~~ m/k-digit data D converted by the data converter into a combination of ~~the~~ coefficients of a fundamental multiple, multiplying the combination by the number X, ~~and outputting the product as a~~ to produce redundant binary partial ~~product~~products;

a redundant binary adder for summing the redundant binary partial products for ~~all~~ each of the ~~digits of the converted number Y~~m/k-digit data D to produce a redundant binary sum; and

a redundant binary (RB)-normal binary (NB) converter for converting the redundant binary sum into a normal binary number and outputting the ~~converted~~ normal binary sum as the product of the two numbers X and Y.

8. A digital multiplication method adopting ~~a~~ redundant binary arithmetic for multiplying ~~two numbers~~ a number X ~~and~~ by an m-bit number Y to produce a product, using a radix-2k number system, the method comprising:

(a) data-converting the m-bit number Y into m/k-digit data D ($= D_{m/k-1}D_{m/k-2} .... D_i ... D_1D_0$);

(b) converting each of the digits Di of the ~~number Y~~ m/k-digit data D into a combination of ~~the~~ coefficients of a fundamental multiple, and multiplying the combination by the number X to obtain ~~a~~ redundant binary partial ~~product~~products;

(c) summing the redundant binary partial products for ~~all~~ each of the ~~digits of the number Y converted~~m/k-digit data D to produce a redundant binary sum; and

(d) converting the redundant binary sum into a ~~normal~~ binary number to obtain the product of the two numbers X and Y.

Amendments to the abstract:

Abstract of the Disclosure

A digital multiplication apparatus and method adopting ~~a~~ redundant binary arithmetic is provided. In this digital multiplication apparatus, when two numbers X and

Y are multiplied using a radix-2k number system, a data converter data-converts the m-bit number Y into m/k-digit data D (= $D_{m/k-1}D_{m/k-2}$ .... D_1 ... D_iD_o). A partial product calculator converts each of the digits Di of the number Y converted by the data converter into a combination of the coefficients of a fundamental multiple, multiplies the combination by the number X, and outputs the product as a redundant binary partial product. A redundant binary adder sums the partial products for all of the digits of the converted number Y. A redundant binary (RB)-normal binary (NB) converter converts the redundant binary sum into a normal binary number and outputs the converted normal binary sum as the product of the two numbers. Therefore, even when the radix extends, the burden upon hardware can be minimized. Also, many systems having multipliers serving as important components can be more simply constructed.